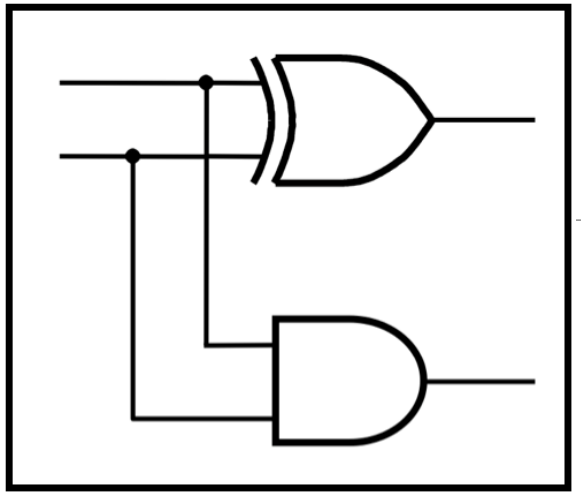


CSE211: Digital Design

Original slides from

Alexander Stoytchev

http://www.ece.iastate.edu/~alexs/classes/

T Flip-Flops
&
JK Flip-Flops

CprE 281: Digital Logic
Iowa State University, Ames, IA

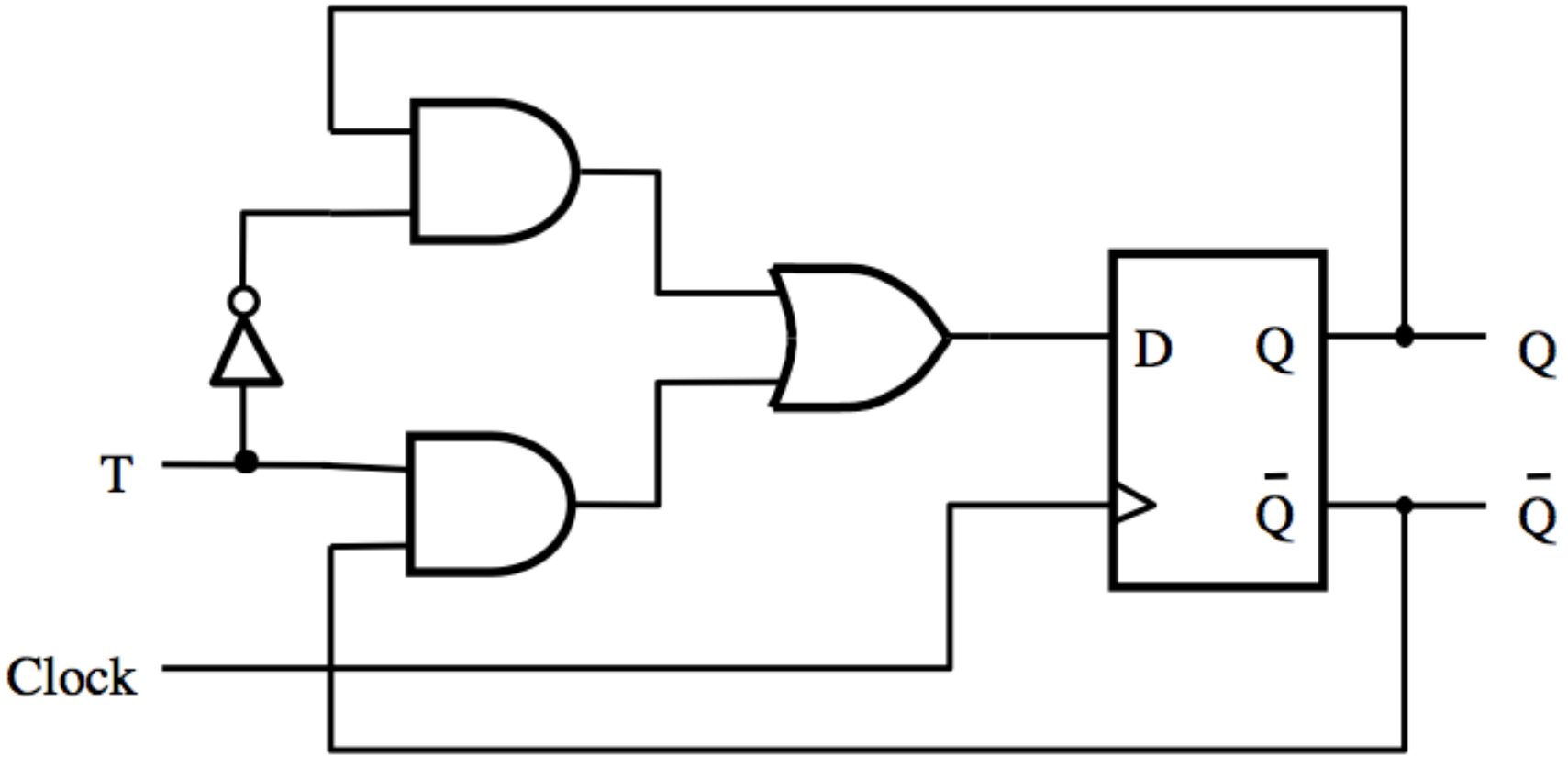
T Flip-Flop

Motivation

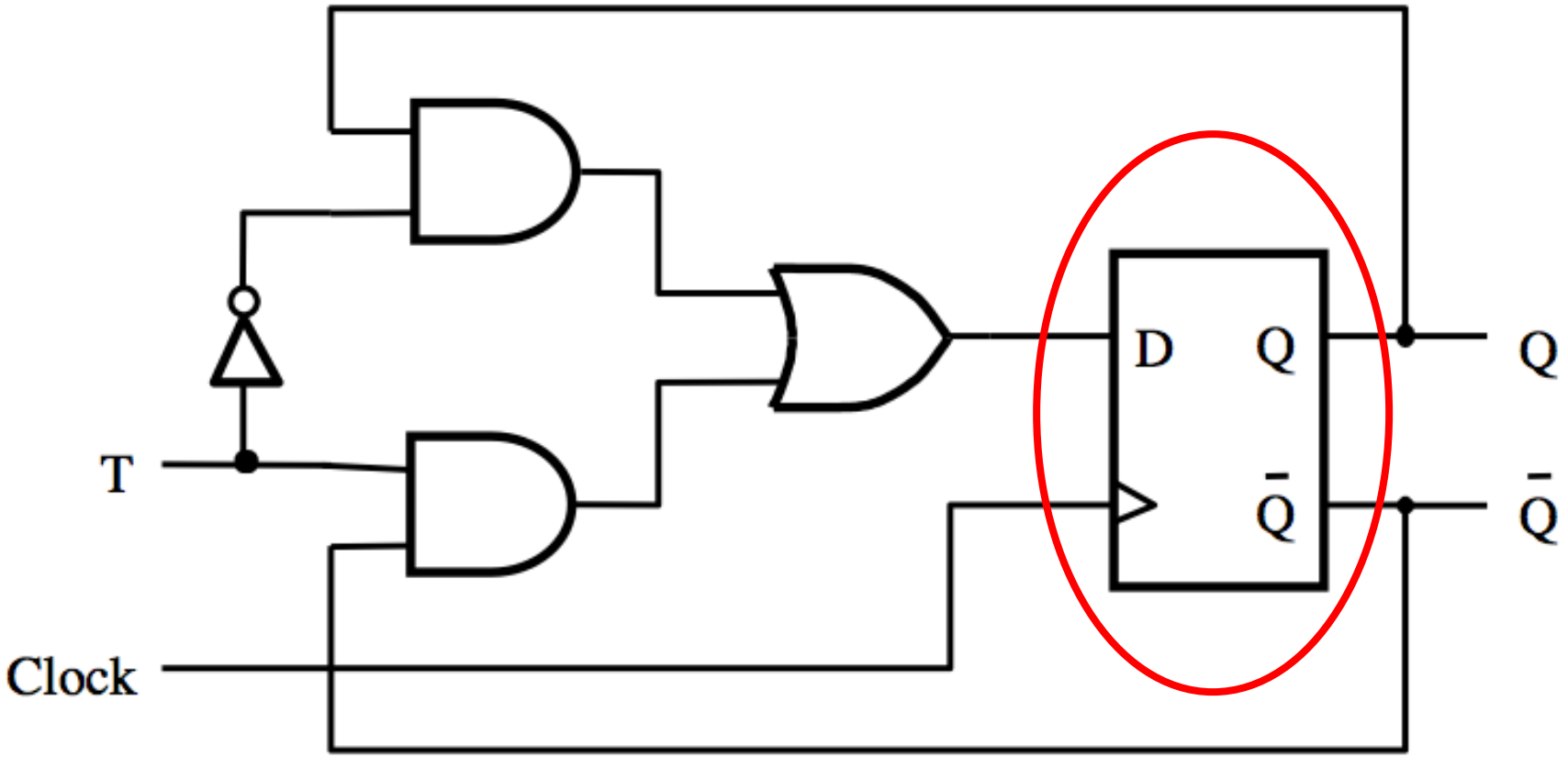
A slight modification of the D flip-flop that can be used for some nice applications.

In this case, T stands for Toggle.

T Flip-Flop

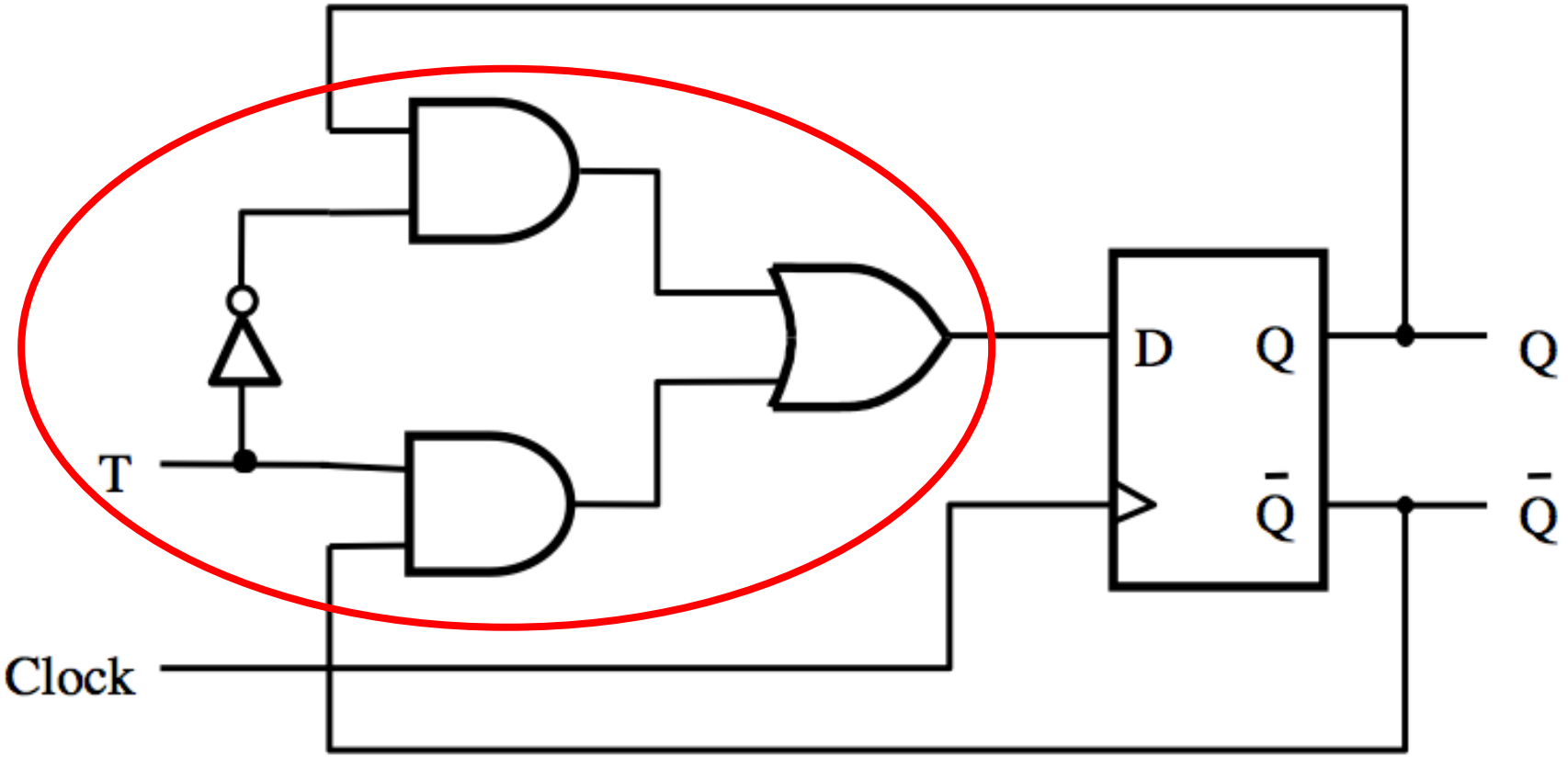


T Flip-Flop



Positive-edge-triggered
D Flip-Flop

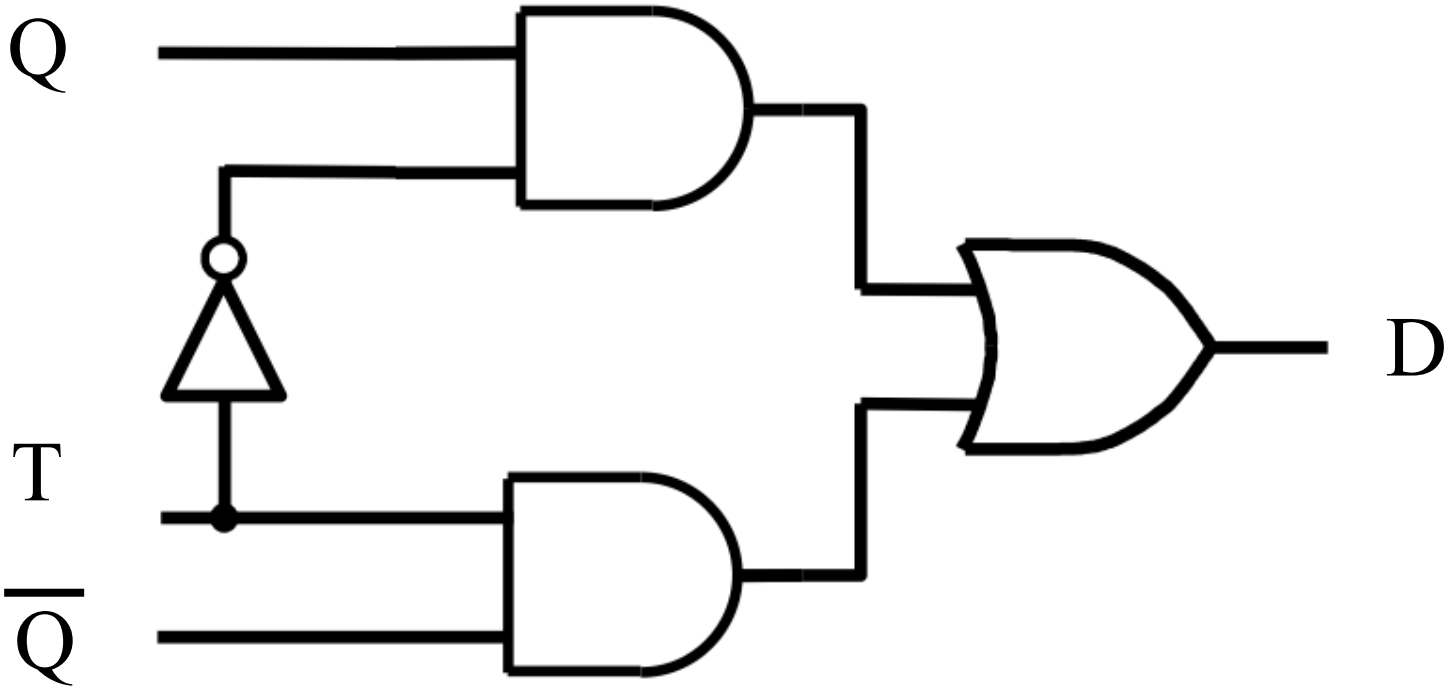
T Flip-Flop



What is this?

[Figure 5.15a from the textbook]

What is this?



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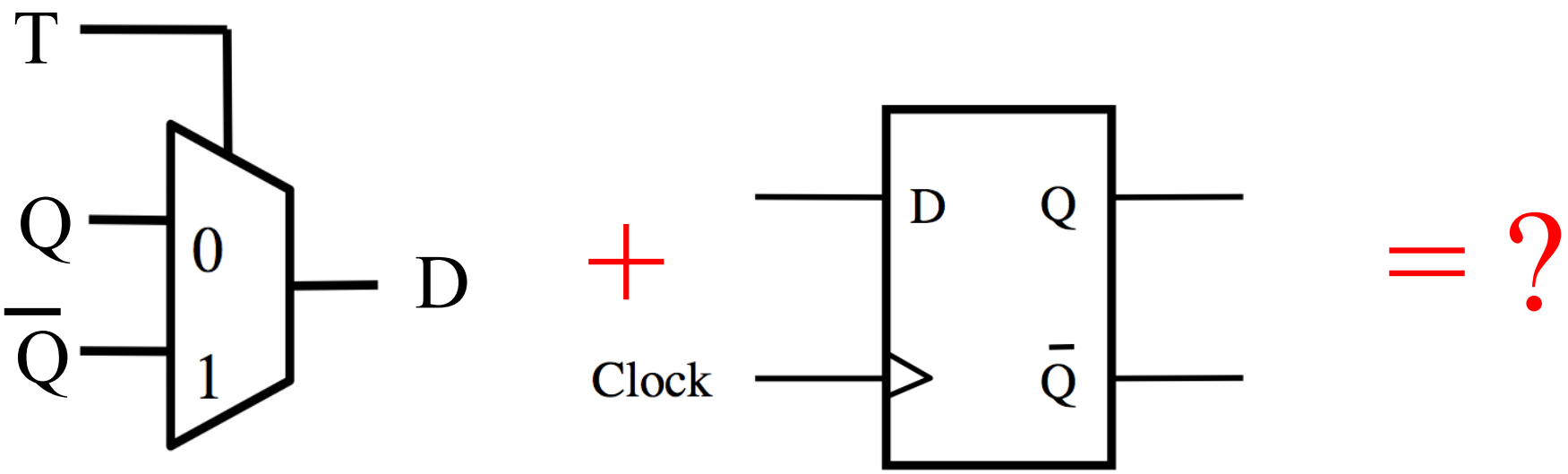
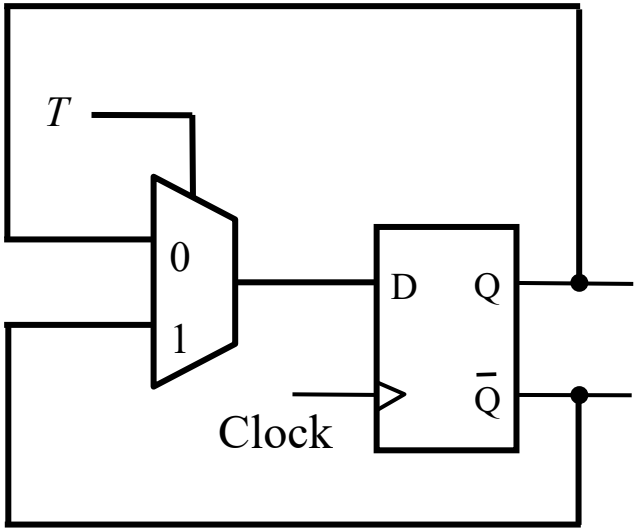


T Flip-Flop



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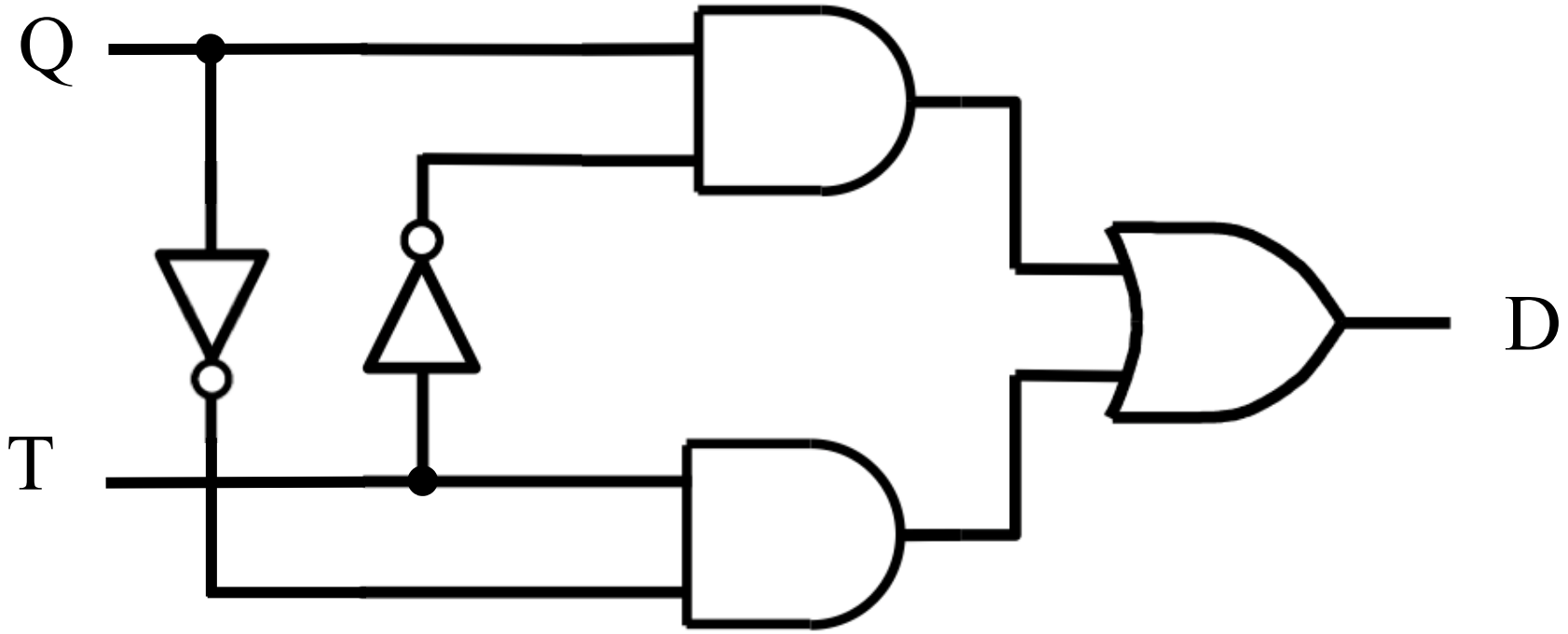

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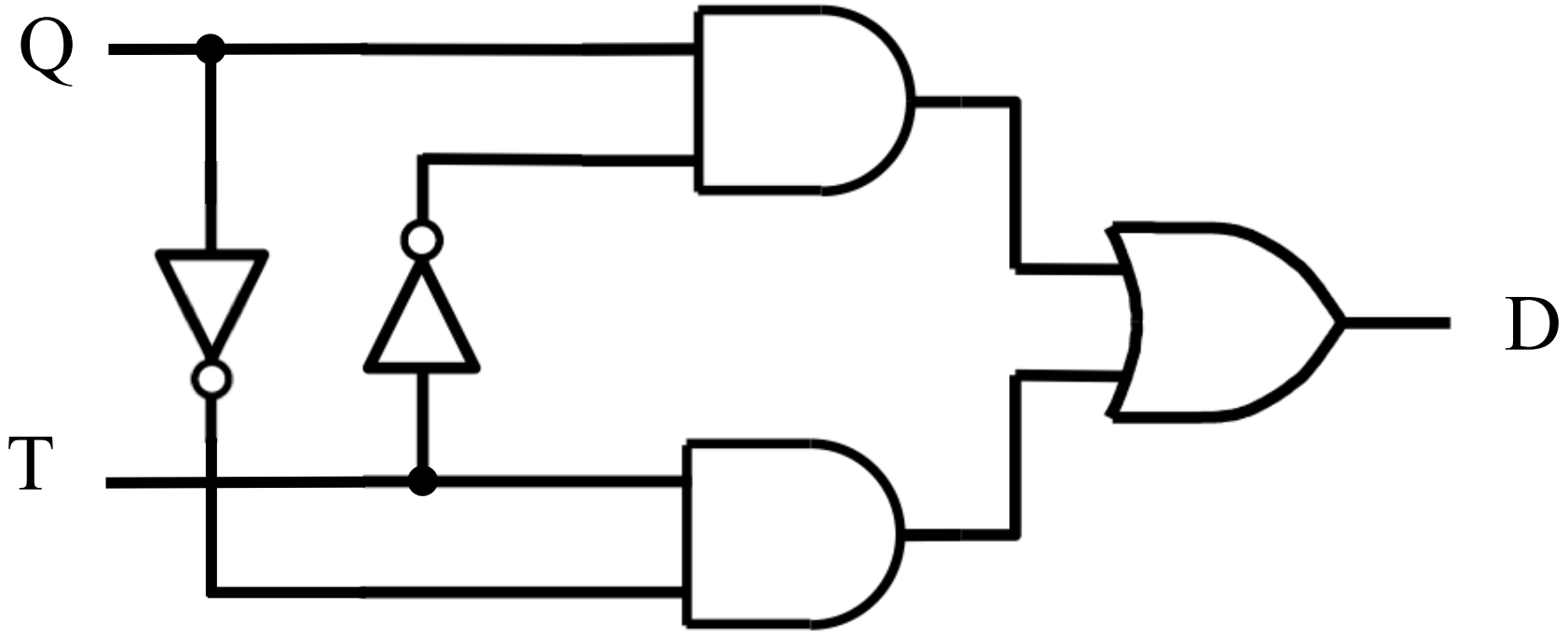
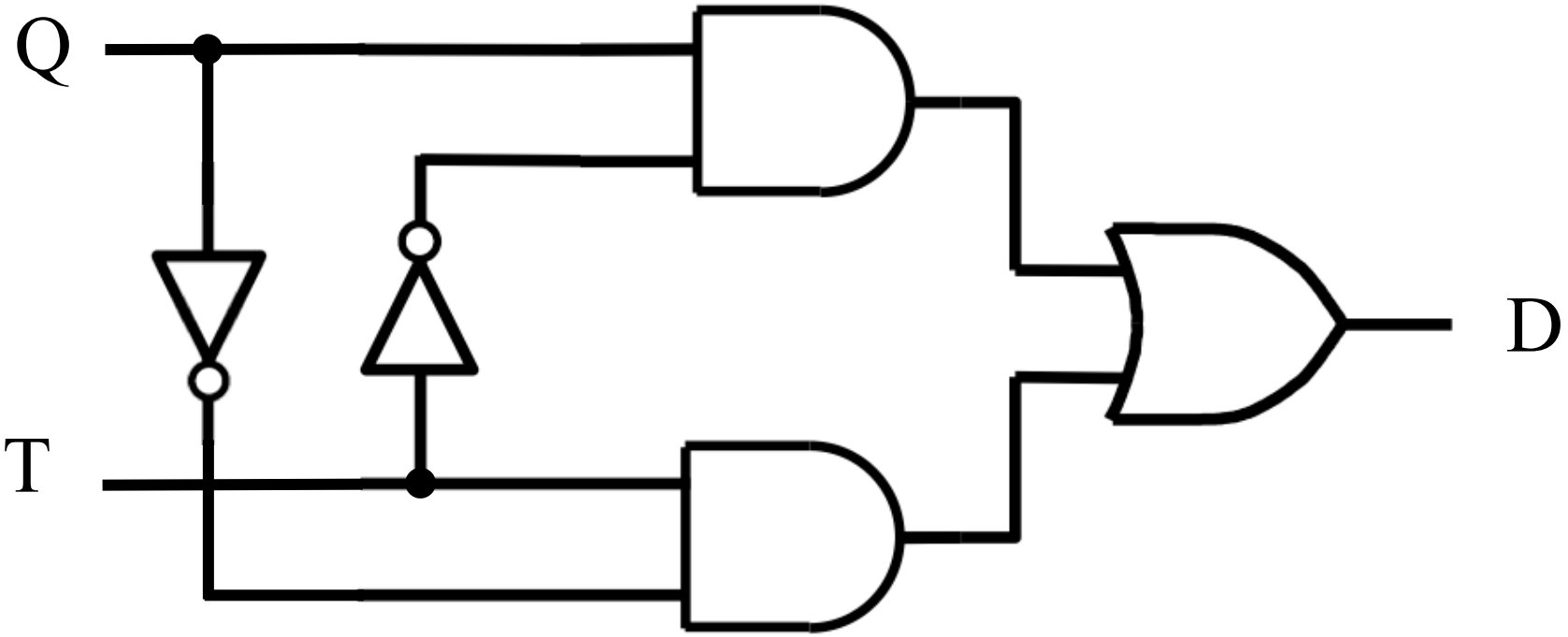


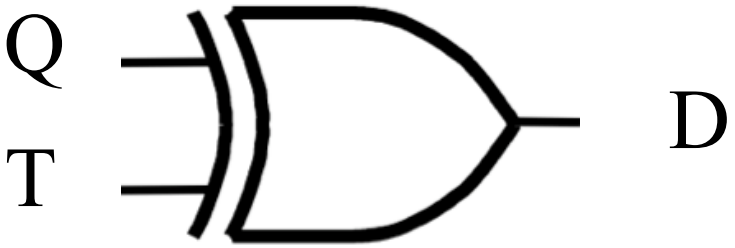
$$D = Q\overline{T} + \overline{Q}T$$

What is this?



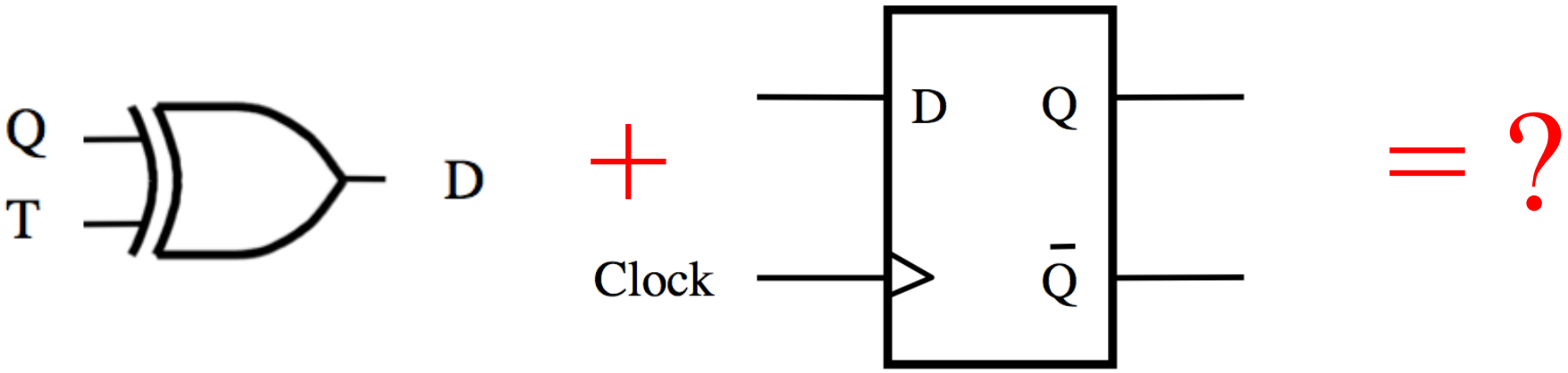
$$D = Q \oplus T$$

What is this?

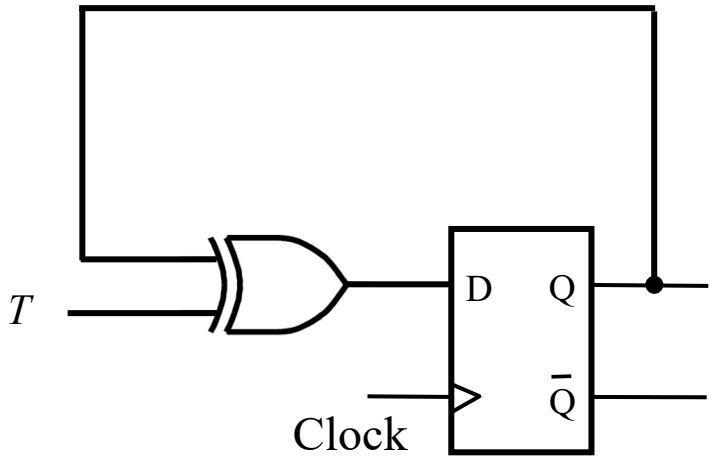


$$D = Q \oplus T$$

What is this?



T Flip-Flop



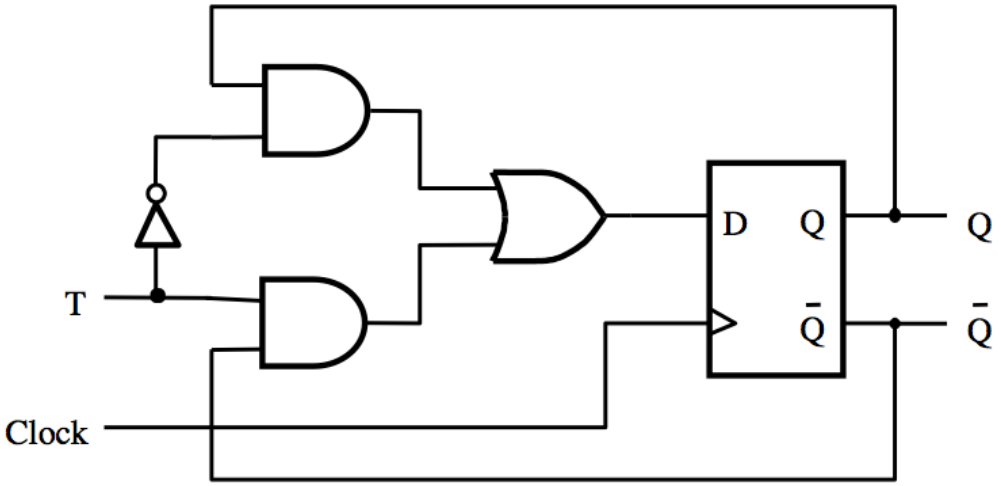
T Flip-Flop (How it Works)

If T=0 then it stays in its current state

If T=1 then it reverses its current state

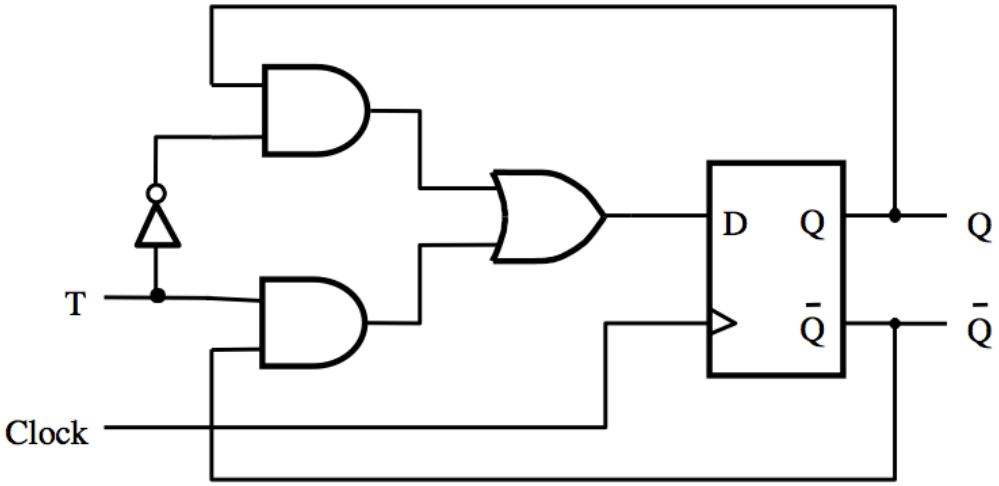
In other words the circuit “toggles” its state when T=1. This is why it is called T flip-flop.

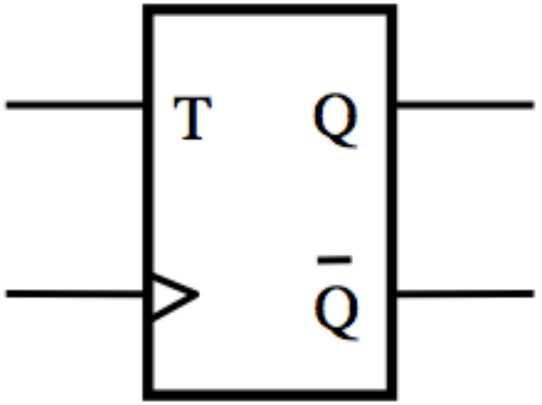
T Flip-Flop
(circuit and truth table)



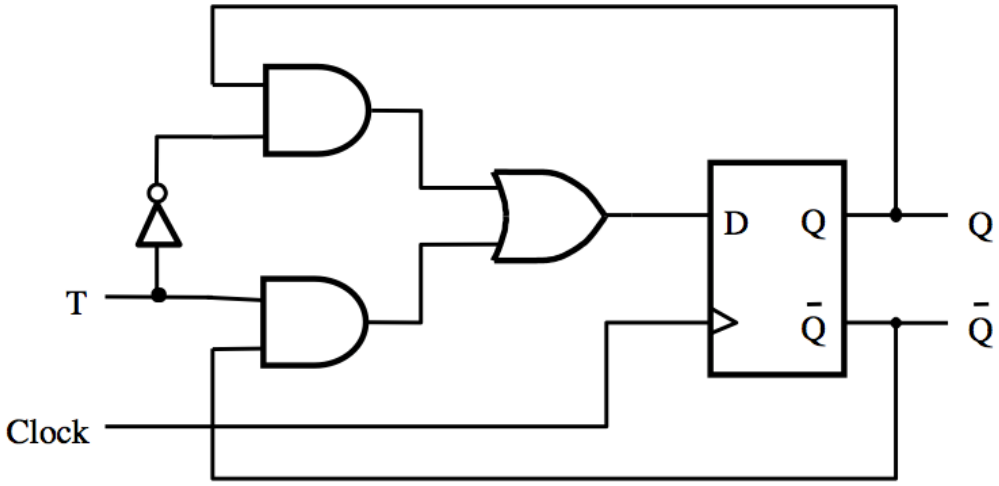
T	$Q(t+1)$
0	$Q(t)$
1	$\overline{Q}(t)$

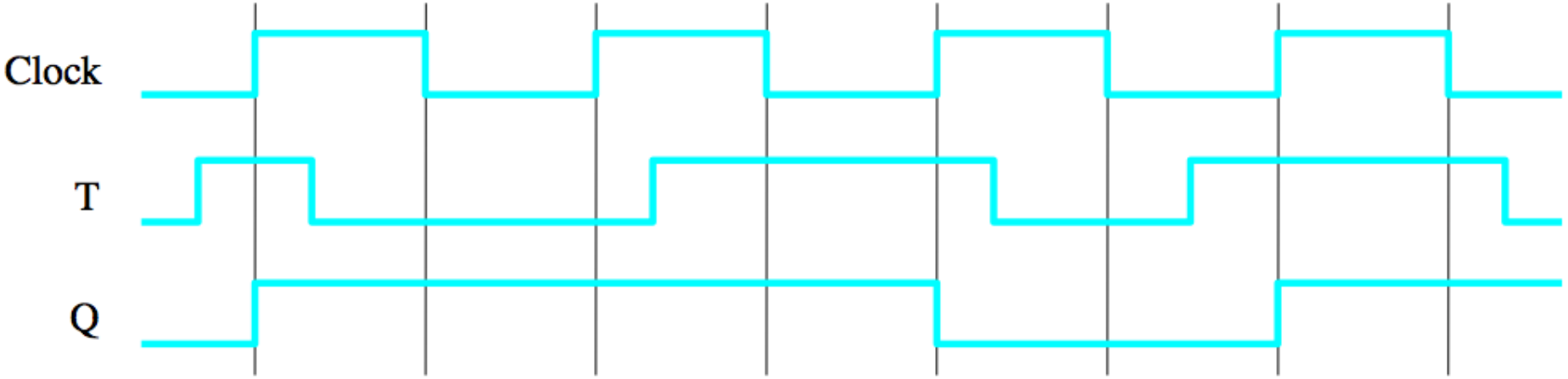
T Flip-Flop
(circuit and graphical symbol)





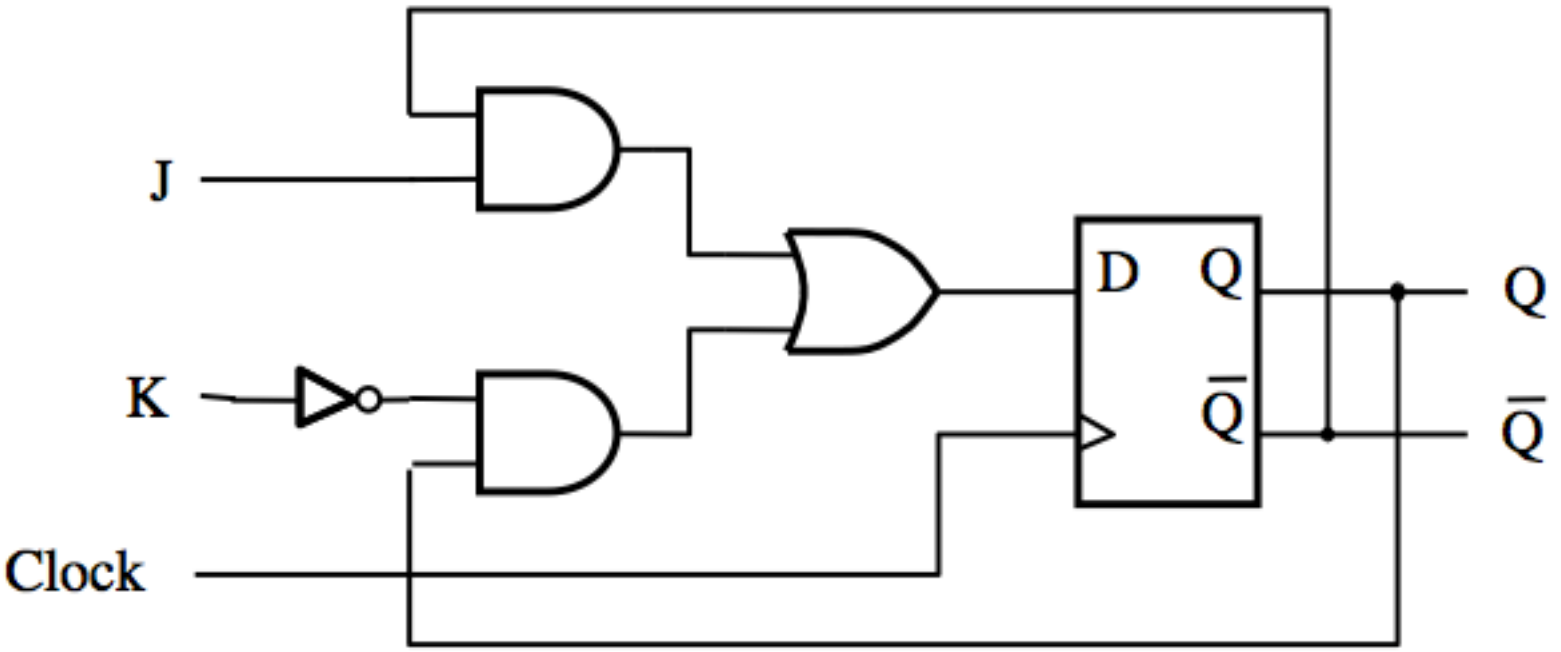
T Flip-Flop (Timing Diagram)





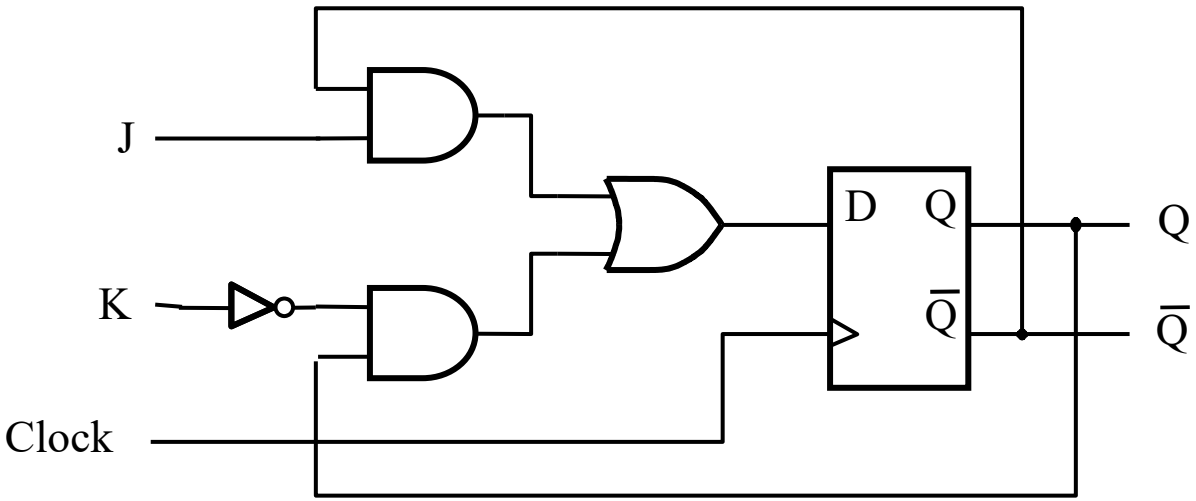
JK Flip-Flop

JK Flip-Flop



$$D = J\overline{Q} + \overline{K}Q$$

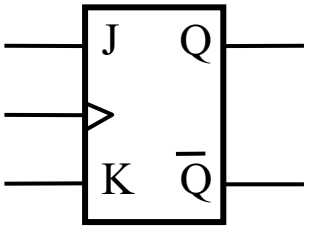
JK Flip-Flop



(a) Circuit

J	K	Q (t+1)
0	0	Q (t)
0	1	0
1	0	1
1	1	$\overline{Q}$ (t)

(b) Truth table



(c) Graphical symbol

JK Flip-Flop (How it Works)

A versatile circuit that can be used both as a SR flip-flop and as a T flip flop

If J=0 and S =0 it stays in the same state

Just like SR It can be set and reset

J=S and K=R

If J=K=1 then it behaves as a T flip-flop

THE END